#13 Appeal Brief
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1/6/03

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the application of:
HUI-JUNG WU, ET AL.

Docket: 30-4731 (4780) DIV-1

Serial Number: 09/841,453

Group Art Unit: 2829

Filed: April 24, 2001

Examiner: Asok K. Sarkar

For: USE OF MULTIFUNCTIONAL SI-BASED OLIGOMER/POLYMER FOR THE SURFACE MODIFICATION OF NANOPOROUS SILICA FILMS

Commissioner for Patents
Washington, D.C. 20231

BRIEF FOR APPELLANT

Sir:

This is an Appeal to the Board of Patent Appeals and Interferences from the Final Rejection of claims 2-28 mailed October 31, 2002 in the above identified case. A Notice of Appeal is being filed concurrently herewith. An oral hearing is not requested.

This Brief is hereby filed in triplicate. The Commissioner is authorized to charge the required appeal brief fee of $320.00 to Deposit Acct. No. 01-1125. In the event that the Commissioner determines that an additional extension of time is required in order for this submission to be timely, it is requested that this submission include a petition for an additional extension for the required length of time and the Commissioner is authorized to charge any other fees necessitated by this paper to Deposit Acct. No. 01-1125.

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I. REAL PARTY IN INTEREST

The real party in interest is Honeywell International, Inc., the assignee of record.

II. RELATED APPEALS AND INTERFERENCES

With respect to other appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board's decision in this appeal, please note that parent application serial number 09/488,075 is on appeal. There are no other related applications on appeal or subject to an interference known to appellant, appellant's legal representative or the assignee.

III. STATUS OF CLAIMS

The claims in the application are 2-29. Claims 2-28 are pending, stand rejected and are on appeal. Claim 29 has been withdrawn from consideration. No claims are allowed.

IV. STATUS OF AMENDMENTS

No response was filed after final rejection.

V. SUMMARY OF THE INVENTION

Concise explanation of the invention defined in the claims involved in the appeal, which refer to the specification by page and line number:

The present invention claims a dielectric film produced by a process comprising the steps of reacting a suitable silica film with a composition comprising a surface modification agent, wherein said silica film is present on a substrate and wherein said reaction is conducted under conditions and for a period of time sufficient for said surface modification agent to form a hydrophobic coating on a surface of said film and said surface modification agent comprises at least one type of oligomer or polymer reactive with silanol groups on said silica film. Specification reference for this concise explanation may be found at page 4, line 5 through page 6, line 10. The process of reacting silanol groups with the surface modifying oligomer or polymer to impart hydrophobicity for the silica film on a substrate may be found in the specification at page 6, line 11 through page 22, line 29, particularly at page 14, line 9, et seq.

VI. ISSUES

(a) Whether claims 2-21 are unpatentable under 35 U.S.C. 103 over Jin (EP 0849796) in view of Burns (US 5,750,610).

(b) Whether claims 22-28 are unpatentable under 35 U.S.C. 103 over Jin (EP 0849796) in view of Burns (US 5,750,610).

(c) Whether claims 2-28 are unpatentable under the judicially created doctrine of obviousness-type double patenting over claims 1-19 of Rutherford et al. (US 6,318,124) in view of Burns (US 5,750,610).

VII. GROUPING OF CLAIMS

The claims do not all stand or fall together, but only stand or fall together within the following groupings of claims.

Group I: Claim 2, directed to the reaction being conducted in the presence of at least one solvent or co-solvent.

Group II: Claims 3 and 4, directed to the structure of the silica film, and to the reaction parameters in order to produce a treated nanoporous silica film having a particular dielectric constant.

Group III: Claim 5, directed to the temperature range of the reaction.

Group IV: Claim 6, directed to the reaction time.

Group V: Claim 7, directed to the makeup of the surface modification agent.

Group VI: Claims 8, 11-14, 17, directed to the preparation of the surface modification agent of claim 7.

Group VII: Claims 9 and 10, directed to the makeup of the solvent or co-solvent.

Group VIII: Claim 15 and 18-19, directed to the makeup of the composition of claim 20.

Group IX: Claim 16, directed to the pre-treatment of the silica film with a monomer surface modification agent, wherein said monomer is reactive with silanol groups on said silica film.

Group X: claim 20, the independent article claim

VIII. ARGUMENTS

Claims 2-21 stand rejected as being unpatentable under 35 U.S.C. 103 over Jin (EP 0849796) in view of Burns (US 5,750,610). Appellants respectfully submit that this ground of rejection is improper.

The invention claims a dielectric film produced by a particular process. According to this process, a suitable silica film *on a substrate* is *reacted with* a composition comprising a surface modification agent. The reaction is conducted under conditions and for a period of time sufficient for the surface modification agent to form a hydrophobic coating on the film. Importantly, the surface modification agent comprises at least one *oligomer or polymer* which is reactive with silanol groups on the silica film.

The examiner asserts that Jin et al. teaches several features of the presently claimed invention. Indeed, Jin et al. discloses dielectric materials comprising an organic silica dielectric on a surface. Further, Jin et al's pore surfaces may be rendered hydrophobic by rinsing with a *monomeric* material such as hexamethyldisilazane (HMDS). However, as the examiner *admits* (page 3, lines 5-6 of the final rejection), Jin *fails* to teach a surface

modification agent which is an *oligomer or polymer*. Such is required by the present claims. Rather, Jin et al.'s reaction with monomeric HMDS serves to cap the silanols by forming trimethylsilyl groups which are significantly less polarizable than the original silanols of the silica, and render the pore surfaces of the film hydrophobic. This is disadvantageous because the use of trimethylsilyl groups are not very thermally stable and may out-gas during processing of interconnect structures and cause via poisoning.

The examiner attempts to fill these deficiencies in Jin et al by citing Burns et al. Indeed, Burns et al. teaches the formation of hydrophobic organosilicate modified silica gels. However, Burns, et al fails to teach a film on a substrate and importantly fails to teach or suggest an oligomer or polymer which is reactive with silanol groups on any such silica film.

The agents used by Burns, et al have the Formulae (I) or (II) on column 3, lines 25, et seq. and are enumerated on col. 6 line 3 through 52. Please note that both the generic formulae and each individual species pertains to a *monomer, not an oligomer or polymer* and certainly not an oligomer or polymer reactive with silanol groups on a silica film. The examiner apparently believes that because some of these are mentioned to be high molecular weight, that they are thereby construed to oligomers or polymer. This is *not the case.* The examiner specifically points to column 7, lines 36-40 of Burns, et al for the proposition that Burns, et al employ oligomers. However, these are not oligomers or polymers. The are monomers.

Indeed, some of these same monomers may be employed as precursors to *form* the polymers and oligomers of this invention (see claims 8 wherein the Applicant's surface modification agent is prepared by *reacting* a suitable monomer with water in a solvent to form said surface modification agent); they may be employed as an *additional* component together with the oligomer or polymer (see claim 15). However, their use in this manner does not detract from the fact that an oligomer or polymer surface modification agent is required by the claims and absent from both Jin, et al and Burns, et al.

In addition, Burns, et al does not teach a silica film *on a substrate, the surface* of which silica film is to be hydrophobized. Rather, Burns et al. form a reaction product of a silica with an organosilane and a strong acid in a flask (see examples), to provide a hydrophobized reaction product. Such does not pertain to a coating on a substrate at all. Therefore Burns is to be considered non-analogous art to the modification of dielectric films on a substrate.

Appellants submit that the Examiner is looking beyond the teachings of the references to justify his finding of obviousness. It is urged that obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion to do so. In re Geiger, 1 USPQ2nd 1276 (CAFC, 1987). Appellants urge that there is nothing in the art to either teach or suggest to one skilled in the art to modify Jin's hydrophobizing process by replacing the hexamethyldisilazane hydrophobizing agent with the agents of Burns, and even if such were hypothetically done, the instant invention still would not be found. Jin, et al's film may be rinsed with monomeric hexamethyldisilazane (HMDS), modifying the pore surfaces of the silica film and rendering them hydrophobic. On the other hand, Burns teaches the formation of a hydrophobic organosilicate-modified silica gel composition wherein the silica composition is first heated in a *strong acidic* environment to form a hydrogel, followed by contacting the hydrogel with a strong acid and an organosilicon compound to render the composition hydrophobic.

Each of Jin et al and Burns teach the formation of different materials using different processing steps that result in a different final product. An invention cannot be deemed unpatentable merely because, in a hindsight attempt to reconstruct the invention, one can find elements of it in the art; it must be shown that the invention as a whole was obvious at the time the invention was made without knowledge of the claimed invention. When selective combination of prior art references is needed to make an invention seem obvious, there must be something in the art to suggest that particular combination other than hindsight gleaned from the invention itself, something to suggest the desirability of the combination. Uniroyal, Inc. v. Rudkin-Wiley Corp., 5 U.S.P.Q.2d 1434, 1438 (CAFC

1988). Such a suggestion is absent in the cited references. There is nothing in the applied art that would lead one skilled in the art to combine the cited references to arrive at the claims.

In summary, the invention provides a dielectric film produced by a process comprising the steps of reacting a suitable silica film on a substrate with a surface modification agent to form a hydrophobic coating on a surface of the film. The surface modification agent comprises at least one type of oligomer or polymer reactive with silanol groups on said silica film. The oligomer or polymer coating on the film surface eliminates the tendency of the film to absorb moisture and strengthens the mechanical properties of the film by overcoating and binding together the fine particles or grains that make up the film. This hydrophobic coating is formed upon contact with the surface of a silica dielectric film. None of these features are taught or suggested by either of the references, either alone or in combination. Further, there is simply nothing therein to suggest that they should be combined. The present invention modifies the surface of a silica film by reacting the silica film on a substrate with an oligomer or polymer reactive with silanol groups on said silica film. Jin, et al solely uses monomers. Burns, et al use high molecular weight monomers in conjunction with a strong acid which cleave their high molecular weight monomers. Nowhere in this combination of references is a silica film on a substrate reacted with an oligomer or polymer reactive with silanol groups on said silica film.

In the instant case, the motives and results in the references, as disclosed therein, are quite different from those in the instant invention. It is urged that the examiner is impermissibly reconstructing the art in light of Appellants' disclosure. The present invention, therefore, is not made obvious by the combination the Examiner has suggested, and the 35 U.S.C. 103 rejections should be overruled.

Claims 22-28 stand rejected under 35 U.S.C. 103 over Jin et al. (EP 08 49796) in view of Burns, et al (U.S. patent 5,750,610). Appellants respectfully submit that this ground of rejection is improper.

The arguments against Jin et al. and Burns et al. are repeated from above and apply equally herein. Appellants respectfully urge that no matter how one applies or combines the cited references, they do not teach the claimed invention or attain its demonstrated benefits. Neither of these applied references teach or suggest an integrated circuit comprising at least one dielectric silica *film* treated by reacting said silica film with a surface modification agent, wherein said reaction is conducted under conditions and for a period of time sufficient for said surface modification agent to form a hydrophobic coating on a surface of said film, and wherein said surface modification agent comprises at least one type of *oligomer or polymer* which is reactive with silanol groups on said silica film.

The invention cannot be deemed unpatentable merely because, in a hindsight attempt to reconstruct the invention, one can find elements of it in the art; it must be shown that the invention as a whole was obvious at the time the invention was made without knowledge of the claimed invention. 35 U.S.C. 103. When selective combination of prior art references is needed to make an invention seem obvious, there must be something in the art to suggest that particular combination other than hindsight gleaned from the invention itself, something to suggest the desirability of the combination. Uniroyal, Inc. v. Rudkin-Wiley Corp., 5 U.S.P.Q.2d 1434, 1438 (CAFC 1988). Such a suggestion is absent in the cited references.

The Examiner's approach seems to be to cite a group of references, figuratively throw all the ingredients of the reference teachings in one pot, and then pull out whichever ingredients are needed to reconstruct the claimed invention. How would one know which ingredients to combine absent the guidance provided in the present application? Where Appellants' teachings are needed to find the invention, the invention is not obvious. Obviousness is determined at the time the invention is made, not after reading Appellants' teaching. 35 U.S.C. 103. Citing references that merely indicate that isolated elements recited in the claims are known is not a sufficient basis for a conclusion of obviousness; there must be something that suggests the desirability of combining the

references in a manner calculated to arrive at the claimed invention. Ex parte Hiyamizu, 10 U.S.P.Q.2d 1393, 1394 (PTO Bd. Pat. Ap. and Int., 1988).

Again it is urged that neither of the cited references, taken alone or in combination, teaches or suggests the invention claimed by Appellants. For these reasons and for the reasons argued for the rejection of claims 2-21 above, it is submitted that the rejections under 35 U.S.C.103 should be overruled.

Claims 2-28 stand rejected under the non-statutory, judicially created doctrine of obviousness-type double patenting over claims 1-19 of Rutherford et al. (U.S. 6,318,124) in view of Burns et al. It is respectfully submitted that the rejection is not well taken.

Rutherford et al. discloses a surface-coated nanoporous silica dielectric film in which a polymeric layer is *deposited as a layer* onto a silica dielectric film on a substrate. As the examiner admits (page 6, paragraph 6 of the final rejection) Rutherford, et al fail to teach that the coating is capable of reacting with silanol groups as a surface modification agent to render it hydrophobic. Rutherford, et al may apply a *monomeric* surface modification agent such as those enumerated on column 8, lines 15, et seq. The surface of the silica dielectric film is then coated with a polymer layer. However, none of the claims indicate that their surface modification agent is an oligomer or polymer *reactive with silanol groups* on a silica film. The coating materials of Rutherford et al. are different than the surface modification agents within the scope of the claimed invention and do not form coatings on silica dielectric films as the claimed films in which surface modification agents which are *oligomer or polymer reactive with silanol groups on said silica film* and form a hydrophobic coating thereon.

Burns et al. also does not teach or suggest a surface modification agent at all, much less one which is an oligomer or polymer which is reactive with silanol groups on a silica film. Regarding, Burns et al., the arguments from above are repeated herein. There is nothing in Burns that would teach or suggest to one skilled in the art to combine the references to arrive at the claimed invention. Particularly, Burns et al. teaches the

formation of a composition in a flask, and not the surface modification of a dielectric film on a substrate. Burns, et al does not teach the use of a oligomer or polymer reactive with silanol groups. Burns further requires certain steps to be conducted in the presence of a strong acid and relates to a non-analogous art, i.e. reinforcing fillers in organic and silicone rubber compositions, as thermal insulation, and as fillers in floatation devices. Thus, it is respectfully asserted that it would not be obvious to one skilled in the art to look a non-analogous art, i.e. an art having absolutely nothing to do with dielectric materials or films, to combine with Rutherford et al. to arrive at the claimed invention. It is submitted that the examiner has impermissibly and hypothetically reconstructed the claims of Rutherford, et al. For these reasons, it is respectfully submitted that the double patenting rejection is improper and should be withdrawn.

For the foregoing reasons it is submitted that the U.S.C. 103 rejections and the obviousness-type double patenting rejection are improper and should be withdrawn.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail, postage pre-paid in an envelope addressed to Commissioner for Patents and Trademarks, Washington, D.C. 20231, on December 26, 2002.

Richard S. Roberts

IX. APPENDIX

2. The dielectric film of claim 20 wherein said reaction is conducted in the presence of at least one solvent or co-solvent.

3. The dielectric film of claim 20 wherein said silica film is a nanoporous dielectric film having a pore structure that comprises silanols, and wherein said reaction is conducted for a period of time sufficient for said surface modification agent to produce a treated nanoporous silica film having a dielectric constant of about 3 or less.

4. The dielectric film of claim 3 that produces a nanoporous silica film having a dielectric constant ranging from about 1.1 to about 3.0.

5. The dielectric film of claim 20 wherein said reaction is conducted at a temperature ranging from about 10°C to about 300°C.

6. The dielectric film of claim 20 wherein said reaction is conducted for a time period ranging from about 10 seconds to about 1 hour.

7. The dielectric film of claim 20 wherein said surface modification agent is a polymer or oligomer that comprises functional groups that will react with silanols.

8. The dielectric film of claim 7 wherein said surface modification agent is prepared by reacting a suitable monomer with water in a solvent to form said surface modification agent.

9. The dielectric film of claim 2 wherein said solvent or co-solvent is selected from the group consisting of ethers, esters, ketones, glycol ethers, hydrocarbons, chlorinated solvents, low viscosity siloxanes and combinations thereof.

10. The dielectric film of claim 2 wherein said co-solvent is selected from the group consisting of ethers, esters, ketones, glycol ethers, hydrocarbons, chlorinated solvents, low viscosity siloxanes and combinations thereof.

11. The dielectric film of claim 8 wherein said monomer is selected from the group consisting of a siloxane, a silazane, a silane, a carbosilane, and combinations thereof.

12. The dielectric film of claim 8 wherein said water is present in said co-solvent in a concentration ranging from about 0.05 to about 10 percent, by weight, relative to the co-solvent.

13. The dielectric film of claim 8 wherein said water is present during said reaction in proportion to said monomer in a ratio ranging from about0.50:1.5 to about 1.5:0.5, mole/mole.

14. The dielectric film of claim 8 wherein said monomer compound is selected from the group consisting of said monomer compound is selected from the group consisting of methyltriacetoxysilane, phenyltriacetoxysilane, tris(dimethlyaimino)methylsilane, tris(dimethylamino)phenylsilane, tris(diethylamino)methylsilane and combinations thereof.

15. The dielectric film of claim 20 wherein the composition comprises an oligomer or polymer surface modification agent and a monomer surface modification agent, wherein said monomer is reactive with silanol groups on said silica film.

16. The dielectric film of claim 20 wherein said silica film is pre-treated with a monomer surface modification agent, wherein said monomer is reactive with silanol groups on said silica film.

17. The dielectric film of claim 8 further comprising adding at least one additional monomer to said solution after the water is fully reacted, wherein said monomer is reactive with silanol groups on said silica film.

18. The dielectric film of claim 15 wherein the monomer surface modification agent is an selected from the group consisting of siloxanes, silazanes, silanes, carbosilanes and combinations thereof.

19. The dielectric film of claim 15 wherein the monomer surface modification agent is selected from the group consisting of acetoxytrimethylsilane, diacetoxydimethylsilane, methyltriacetoxysilane, phenyltriacetoxysilane, diphenyldiacetoxysilane, trimethylethoxysilane, trimethylmethoxysilane, 2-trimethylsiloxypent-2-ene-4-one, n-(trimethylsilyl)acetamide, 2-(trimethylsilyl) acetic acid, n-(trimethylsilyl)imidazole, trimethylsilylpropiolate, trimethylsilyl(trimethylsiloxy)-acetate, nonamethyltrisilazane, hexamethyldisilazane, hexamethyldisiloxane, trimethylsilanol, triethylsilanol, triphenylsilanol, t-butyldimethylsilanol, diphenylsilanediol, tris(dimethylamino)methylsilane, tris(dimethylamino)phenylsilane, tris(dimethylamino)silanemethyltrimethoxysilane, methyltris(methylethylkeoxime)silane. methyltrichlorosilane, and combinations thereof.

20. A dielectric film produced by a process comprising the steps of reacting a suitable silica film with a composition comprising a surface modification agent, wherein said silica film is present on a substrate and wherein said reaction is conducted under conditions and for a period of time sufficient for said surface modification agent to form a hydrophobic coating on said film and said surface modification agent comprises at least one type of oligomer or polymer reactive with silanol groups on said silica film.